is improved.

In the step 5, even when the type of gas having a semiconductor substrate 1 exposed thereto is N_2, Ar, or forming gas (a mixture gas of N_2 and H_2), the above described advantageous effect is observed. In the case of forming gas, there is achieved an effect which is more advantageous by about 1.5 times as compared with N_2 or Ar.

In the step 5 (pre-step) of the present embodiment, the position (gap) semiconductor is changed, at least one other parameters can be changed. The parameters are pressure in the reactor chamber, temperature of the semiconductor substrate 1, type of gas having the semiconductor substrate 1 exposed thereto, flow rate of the gas introduced into the reactor chamber, and position of the semiconductor substrate 1. Further at least two parameters including the position of the semiconductor substrate 1 can be changed.

In terms of the direction of change of the parameters, the direction of increasing is applicable to the temperature, the direction of increasing and decreasing are applicable to the pressure and the flow rate and the gap. The realistic change of the type of gas is from argon or nitrogen to mixture of these. These parameters at the step 5 can be specifically changed in the same range as those at the step 4. The

heat treatment of the pre-step is carried out in the reactor container for carrying out the electron beam irradiation process in the same way as that at the post-step. The heat treatment of the pre-step is sequentially carried out together with the electron beam irradiation process.

In the present embodiment, the parameter is changed in the heat treatment of the post-step, it can be changed in a heat treatment of the pre-step. The heat treatment of the pre-step means the heat treatment of the step 3. In this case, the step 2 can be merged with the step 3, and the step 3 can be omitted. In this case the direction of change of the temperature, the pressure, the gas flow rate, and the gap are same those of the pre-step. The change of the type of gas is from nitrogen to argon, or from argon to nitrogen. Further, the parameter can be changed in the heat treatment of the pre-step and the post-step.

(Third Embodiment)

Now, a method for manufacturing a semiconductor device according to a third embodiment of the present invention will be described here. The present embodiment is different from the first embodiment in view of the method for forming an interlayer insulation film 3. An outline of the above process is given below (steps 1 and 2).

Step 1: A vanish is applied on a semiconductor

substrate 1 by using a spin coating technique.

Step 2: An electron beam is irradiated on the semiconductor substrate 1 while the semiconductor substrate 1 is heated in a reduced pressure nitrogen atmosphere, and the interlayer insulation film 3 is formed.

The above process will be described in more detail. First, as in the first embodiment, the step 1 is executed, and a coat film is formed.

Next, the above semiconductor substrate is placed on a hot plate held at 400℃ in the reduced pressure nitrogen atmosphere, a coat film is irradiated with electron beams, and the interlayer insulation film 3 is formed (step 2). The above electron beam irradiation is carried out in a condition of 6 keV in the electron beam energy and 50 $\mu C/cm^2$ in total irradiation quantity.

Here, by virtue of a reason similar to that stated in the step 4 of the first embodiment, it is desirable that the step 2 be in reduced pressure atmosphere in which the oxygen concentration is restrained to 100 ppm or less.

Further, by virtue of a reason similar to that stated in the step 4 of the first embodiment, it is desirable that the substrate temperature be set to 200℃ or more and not more than 500℃ in the heating process of the step 2 by virtue of a reason similar to that